

## **RADIATION CURING AND DRYING**

### **BACKGROUND OF THE INVENTION**

The present invention relates generally to the drying and setting of materials, and more particularly, but not limited to, the drying ink and paint coatings.

A variety of industrial, commercial and consumer goods require a solidification process, either removal of liquids contained in the structure of the goods, or a coating applied thereon, or by catalysis of the goods themselves or their coatings. Some materials require a curing process that may be usually initiated by the addition of some form of energy. In the case of many inks and coatings, the removal of some or all of the liquid portion to initiate solidification releases a large perfusion of fumes and vapors, many having known health risks. Commonly, a large volume of high-velocity heated air is directed at the surface, even though only a fraction of the air actually comes even near the surface, due to the difficulty in penetrating through the "boundary layer effect" of vapors and gasses near the surface. The countercurrent of fumes and vapors clinging to the surface also create a barrier against convective heating as well as preventing radiation from reaching the surface of the material to be dried.

Electrostatic precipitators generally will not remove gasses, so an odor would remain. Large high-pressure fans are required to even partially penetrate the boundary layer near the surface of the material, and once the blast of hot air, fume and vapors has left the surface it is not usually reused, but is "cleaned up" and exhausted into the atmosphere. Due to the huge volumes of air contaminated with vapors and fumes produced by this process, removal of the contaminants through incineration or high-temperature catalysis is expensive and wasteful, often doubling the energy expenditure of the initial drying operation. Water based coating drying systems, while not requiring as much "clean-up" of the effluent, still require substantial amounts of energy and process time due to the high latent heat of vaporization of water, thus slowing production rates.

## **SUMMARY OF THE INVENTION**

The present invention discloses a drying system comprising: a blower that passes air over flames electrically charged to a high-voltage source, ionizing rods containing rows of pins, some of which are connected to ground and some to a high-voltage DC supply, and insulated strands of wire in the effluent stream for collecting the ionized fumes and solvents.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

Fig. 1 shows a semi diagrammatic view of the system for drying one side of a continuous web using the concepts of this invention.

Fig. 2 shows a pictorial view of the invention showing an overall external view.

## **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Referring now specifically to the drawings, Fig. 1 shows diagrammatically a drying system in accordance with the present invention. The purpose of the illustrated system is to rapidly dry and cure printing inks or coatings applied upstream on the web by a printing press or coater of common design and construction which is located upstream (not shown). Although the illustrations depict a paper web with uncured or wet printing ink applied thereto, the present method and apparatus will be understood to apply to objects of various shapes and compositions. These objects may themselves be solidified, dried or cured, or they may have a surface or internal coating to be altered. Inks, coatings, films and plastics may be formulated which are particularly susceptible to being selectively altered by the ultraviolet radiation and ozone produced by this system.

As illustrated in Fig. 1, the web enters from the right and passes under the outlet from duct 2 that encloses preheated air 1 descending past heated tubes 4 that are maintained at a high voltage negative potential by wire 5 connected from DC power supply to said tubes thereby causing an electrostatic field 8 between the flames 7 in serrated channel 6 to the web 10 and the ink image 9 applied thereto, and thence to charge bars 11 connected to the power supply ground by wire 12.

These heated tubes are referred to hereinafter as "charge tubes" and may or may not have flames emitting therefrom. "Charge bars" are elongated, insulated structures have exposed conductive surfaces from which an electrostatic charge emanates, usually in the form of a row of oxidation-resistant pins usually internally electrically interconnected. There are commercially available variations, some having the

individual pins connected to a common bus by resistors, which serves to even out the electrostatic field and reduce arcing. They are usually constructed of an insulating material, and have an internal electrical connection from the conducting surfaces to a connection plug or terminal.

The flow of electrical current through said electrostatic field and web to the charge bars **11** creates additional heating added to the convective heat from the airstream **1**, and said heating impinging on the web and the ink applied thereon, causes vaporization and oxidizing of some of the ink components. With sufficiently high voltage, a corona may be caused to occur on the surfaces being treated, which may solidify certain inks. Ozone may also be produced which may rapidly oxidize certain inks and coatings. The vapors and fumes **16** emanating from said web and ink into the electrostatic field acquire a charge. Convective movement away from the web by said fumes and vapors **16** is assisted by said acquisition of a negative charge **15**, said charge causing them to be repelled from the surface of the web that now passes over negatively charged bars **14**. Said fumes and vapors move into up into duct **20** by a combination of suction airstream **21** and repulsion from a negative charge on the plurality of charge bars **14**, said bars being connected to the power supply by wire **13**. The ionized vapors and fumes **16** are attracted to wires **18** that are at a positive high-voltage potential, said vapors and fumes adhering to said wires in the form of liquid and solids **19** that runs down said wires into receptacles **17** for removal and recycling. Special inks may be formulated that are particularly sensitive to exposure to electrons in the electrostatic field, said inks adhering to said web undergoing a reaction so disposed as to cause curing and solidification. Removal of the fumes and vapors attracted to wires **18** may be facilitated by wires that are formed into an endless belt, whereby said wires may be continuously cleaned by moving past a cleaning means such as a brush or scraper.

Although drying of only one side of a web is depicted, it is understood that by inverting or re-orienting the structures of the present invention, drying or curing may be effected on opposing sides of any object, the top and bottom of a web printed or coated on both sides in this instance.

Fig. 2 shows the present invention in an overall view of the preferred embodiment for drying or curing the top of a web. Blower 25 driven by motor 26 draws environmental air into adjustable aperture 1 and expels said air through preheater 27, into duct 2 where it moves across ionizing bars 4 and impinges against the top of web 10 which enters housing 7 through elongated aperture 28. High-voltage supply 29 is connected by ground wire 12 to the housing. Insulated negative high-voltage wires 5 and 13 connect to the ionizing bars 4 and 14 respectively. Collector wires 18 (shown in Fig.1) are connected to the positive high-voltage terminal of said power supply by insulated wire 24. Liquid captured from the airstream 21 is conveyed by drain tube 30 into an appropriate container. Remaining contaminants in the airstream 21 are removed by conventional filtering means 22. A portion of the air exiting from said filtering means is recycled into the inlet of blower 26 by duct 23.